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EXTRAORDINARY

PART II—Section 3—Sub-section (i)

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MINISTRY OF WORKS, HOUSING AND SUPPLY

(Central Boilers Board)

NOTIFICATION

New Delhi, the 18th August 1962

G.S.R. 1093.—In exercise of the powers conferred by Section 28 of the Indian Boilers Act, 1923 (5 of 1923), the Central Boilers Board hereby makes the following Regulations further to amend the Indian Boiler Regulations, 1950, the same having been previously published as required by sub-section (1) of section 31 of the said Act, namely:—

1. These Regulations may be called the Indian Boiler (Twentieth Amendment) Regulations, 1961.

2. In the Indian Boiler Regulations, 1950—

(1) In regulation 4(e), between the words "make" and "and" appearing in the last line the following words shall be inserted, namely:—

"tolerance within which they have been manufactured".

(2) For regulation 5(iv), the following shall be substituted, namely:—

"When the quality of material and the make of steel pipe have not been supported by certificates from the manufacturers, the pipes shall be treated as roll lap welded steel pipes and the maximum permissible working stress will be reduced by 25 per cent. and they shall be presented for a hydraulic test before erection *in situ*".

(3) For regulation 298, the following shall be substituted, namely:—

"*Discharge Passage.*—The safety valve discharge pipes shall comply with the requirements of clauses (a) and (b) of this regulation. The discharge pipe shall be as short and straight as possible and be fitted with open drain to prevent accumulation of water in the pipe. Suitable arrangement shall be provided in the discharge pipe system so that the discharge can readily be heard by the Boiler Attendant.

(a) Steam safety valves.

(i) Ordinary and high lift valves. Where a waste steam pipe is fitted, the pipe and the passage leading to it shall have a cross-sectional area not less than the minimum combined area of the safety valves required by regulation 293.

(ii) Full lift valves. For full lift valves the area of waste steam-pipe and passages leading to it shall have a cross-sectional area not less than twice A, or such area above this minimum as may be required for valves having a higher approved constant, where A, E and P are as defined in regulation 293.

(b) Economiser safety valves. The area of the discharge pipe from an economiser safety valve shall be at least twice the area of the valve seating.

Where the discharge from several economiser safety valves is connected to the main discharge pipe, the diameter of the main discharge pipe shall be designed to prevent accumulation of pressure due to the formation of steam under the particular conditions of temperature and pressure which may be applicable."

(4) For regulation 317, the following shall be substituted, namely:—

"317. *General.*—The blow down cock or valve shall be of substantial construction. The waste pipe attached to the cock or valve shall not be bound fast in earth or brick work and shall discharge at a point where there is no danger of injury to any person. These pipes shall not be connected to a pipe common to another boiler. The continuous blow downs may, however, be connected to a common header discharging freely to an adequately vented tank or sump. The headers shall be of sufficiently large cross section and the blow-off tank shall be provided with a vent pipe free from valves and of sufficient size to prevent accumulation of pressure. If, however, the tank is intended for collecting flash steam, a safety valve of adequate capacity shall be provided. The tank shall be so located that all parts will be accessible for inspection."

(5) For regulation 343, the following shall be substituted, namely:—

"343. *Pipes.*—Steam pipes may be carbon steel, cast steel, alloy steel and in some cases of copper. Steel pipes may be solid drawn (cold or hot finished), lap welded, butt welded or electric resistance welded. Copper pipes shall be solid drawn and no pipe made from electro-deposition of copper on a mandril shall be used for steam delivery."

(6) For regulation 344, the following shall be substituted, namely:—

"344. *Steel Pipes.*—(a) These pipes shall be made from steel made by the open hearth or an electric process acid or basic. Hot finished seamless and roll lap welded pipes, may, however, be made of basic Bessemer steel. Basic Bessemer steel shall not be used for pressures exceeding 21 kg/cm^2 (300 lbs. per sq. in.) or temperature exceeding 260°C (500°F). If the Bessemer process is used, the steel shall be made by a manufacturer approved by the Inspecting Authority.

When used for steam temperature exceeding 399°C (750°F), the steel shall be of the non-segregated or fully killed type.

(b) Carbon and alloy steel pipes shall not be used for design temperatures exceeding those given in Table 2.

(c) For designed temperature over 427°C (800°F) special precaution shall be taken to ensure that the surface condition of the pipe is suitable for these requirements.

(d) The materials from which seamless and electric resistance welded pipes are made shall conform to the appropriate specification of tubes in Chapter II. The materials from which roll lap welded, hydraulic lap welded and butt welded pipes are to be made shall conform to the requirements of Table I under Regulation 347."

(7) For regulations 346 and 347, the following shall be substituted, namely:—

"346. *Number of sets of tests.*—The number of pipes on which mechanical tests shall be performed shall be as follows:—

Seamless pipes:

Upto and including 114 mm. (4½ in.) o.d.	As per requirements of Chapter II.
Over 114 mm. o.d. . .	5 per cent of the lengths of pipe as made, or 2 per cent cent of the pipes from each cast where the cast (*i.e.*, melt) can be identified.
Welded pipes . . .	2 per cent of the lengths of pipes as made.

In the case of pipes for designed temperatures over 427°C (800°F) every pipe over 114 mm. (4½ in.) outside diameter shall be tested.

347. (a) *Flattening test* [*for pipes upto and including* 102 *mm.* (4 *in.*) *nominal bore*].—As per requirements of Chapter II.

(b) *Cold bend test* [*for pipes over* 102 *mm.* (4 *in.*) *nominal bore*].—A strip not less than 38 mm. (1½ in.) wide cut circumferentially from one end of each selected pipe shall when cold withstand, without showing either crack or flaw, being doubled over in the direction of original curvature round a bar, the diameter of the bar being:—

For pipes upto and including 10 mm. (3/8 in.) thick.	3 times the thickness.
For pipes over 10 mm. thick.	4 times the thickness.

(c) *Bend test on the Weld.*—A strip not less than 38 mm. (1½ in.) wide cut circumferentially from one end of each selected pipe with the weld near the middle of the strip, shall when cold withstand, without showing either crack or flaw, being doubled over in the direction of original curvature round a bar, the diameter of the bar being equal to eight times the thickness of the test piece, the weld being placed at the point of maximum bending.

(d) *Additional test.*—Should a pipe selected for testing fail in any one or more of the tests specified above, two further tests of the same kind may be made from the same or another pipe from the same batch. Should either of these further tests fail, the pipes represented may be reheat treated and then retested. If the repeat tests are satisfactory, the pipes shall be accepted provided they comply with other requirements but if failure again occurs, the pipes which the test pieces represent shall be rejected.

(e) *Tensile test.*—As per requirements of Chapter II.

TABLE I—CARBON STEELS

Roll Lap welded and Butt welded pipes

Kind of pipes	Ultimate tensile strength in Kg./Sq. mm. (tons per sq. in.)		Minimum elongation per cent.				Sulphur per cent max.	Phosphorus per cent max.
			On 203 mm. (8 in.)		On 51 mm. (2 in.)			
	Not less than	Not more than	6 mm. (1/4") thick and over	Less than 6 mm. (1/4") thick	6 mm. (1/4") thick and over	Less than 6 mm. (1/4") thick		
Strips cut from the pipes clear of the welds and tested in their curved condition	35 (22)	44 (28)	20	18	32	30	·06	·06
Test lengths taken from finished pipes (ends of pipes to be plugged for grips) . . .	35 (22)	44 (28)	25	23	..	..		

TABLE I—CARBON STEELS

Hydraulic (water gas) Lap welded Steel Pipes.

Selected Samples cut transversely	Ultimate tensile stress in Kg./ sq. mm (Tons/ sq. in.)		Min. Elongation per cent on 203 mm. (8")			Sulphur maximum %	Phosphorus maximum %
	Not less than	Not more than	13 mm (1/2") thick and over	Less than 13 mm. thick and not less than 6 mm. (1/4") thick	Less than 6 mm. thick		
	36 (23)	44 (28)	23	20	18	0·05	0·05

(8) For regulation 348, the following shall be substituted, namely:—

"348. *Method of manufacture, Heat treatment and Marking.*—(a) The process of welding lap jointed seams shall be by hammering or rolling the joint. The pipe shall be carefully annealed, thereafter.

(b) On completion of any work which involves heating, whether for hot bending of the pipe or for any other similar purpose, the pipe shall be carefully annealed.

(c) Cold drawn carbon pipes shall be carefully annealed throughout their lengths after the operation of drawing.

Cold drawn seamless alloy steel pipes shall be delivered in the normalised condition and hot finished pipes in the as rolled, or hot drawn condition or in the normalised condition.

(d) *Marking.*—Inspection and identification marks shall be stamped on end faces of pipes plain at ends. These marks shall be machined or ground off before erection. When flanges are fitted identification marks shall be stamped on the rims of flanges.

(9) For regulation 349, the following shall be substituted, namely:—

"349. The pressure and temperature limits within which pipes, tees, branches, etc., shall be used, shall be in accordance with Table 2."

TABLE 2

Maximum permissible working pressure and temperature

Material	Method of manufacture	Maximum permissible working pressure	Maximum permissible temperature		Form
			°C	°F	
Carbon steel	Cold drawn seamless .	No restriction	482	900	Straights, bends or fittings.
	Hot finished seamless .	Do.	482	900	Do.
	Hydraulic lap welded .	Do.	482	900	Do.
	Roll lap welded, butt welded [Max. nominal bore allowable 102 mm (4 in.)].	21 Kg/Cm² (300 lb /sq. in.)	260	500	Do.
	Electric resistance welded [Max. nominal O.D. 114 mm (4½")] . .	No restriction	482	900	Straights
Cast steel	Castings . . .	No restriction	482	900	Straights, bends or fittings.
Molybdenum steel	Cold drawn seamless and castings.	No restriction	524	975	Do.
Chromium molybdenum Steel	Cold drawn seamless and hot finished seamless .	No restriction	621	1150	Do.
Copper	Solid drawn upto and including 127 mm (5 in.) dia.	12·6 Kg/Cm² (180 Lbs/sq. in.)	Not allowed for superheated steam		Straights and bends.

(10) For regulation 350, the following shall be substituted, namely:—

"350. *Steel pipes.*—The maximum working pressure allowed on steel pipes shall be determined by the following formula:—

$$W.P. = \frac{2\ Se\ (t-c)}{D} \qquad \text{(Equation 91)}$$

t = minimum thickness.

W.P. = Maximum working pressure.

Where the total relieving capacity of the safety valve on the superheater is not less than 20 per cent of the total evaporative capacity of the boiler, the steam pipes may be designed for a pressure at which any superheater safety valve is to be set to lift provided that in no case shall these pressures be less than 91 per cent of the design pressure of boiler.

D = Outside diameter of pipes.

S = Allowable stress as specified in Table 3.

e = Efficiency factor.

= 1 for seamless and electric resistance welded steel pipes

= ·9 for welded steel pipes for values of t up to and including 22 mm (7/8")

= ·85 for welded steel pipes for values of t over 22 mm (⅞") and up to and including 29 mm (1⅛")

= ·8 for welded steel pipes for values of t over 29 mm (1⅛")

c = 0·1 cm (·04 in.)

TABLE 3

Maximum permissible working stress for straights, bends or fittings

Material and method of manufacture	Upto and including 260°C (500°F)	Over 260°C (500°F) up to & including 288°C (550°F)	Over 288°C (550°F) up to & including 316°C (600°F)	Over 316°C (600°F) up to and including 343°C (650°F)	Over 343°C (650°F) up to and including 371°C (700°F)	Over 371°C (700°F) up to and including 399°C (750°F)	Over 399°C (750°F) up to and including 427°C (800°F)
Carbon steel							
A. Roll lap welded and butt welded, and Bessemer hot finished seamless.	865 kg./cm² (12,300 lb./sq. in.)	Not used for these temperatures					
B. Castings	822 kg/cm² (11,700 lb./ sq. in.)	794 kg/cm² (11,300 lbs./sq. in.)	745 kg/cm² (10,600 lbs./sq. in.)	703 kg/cm² (10,000 lbs./ sq. in.)	654 kg/cm² (9,300 lbs./ sq. in.)	605 kg/cm² (8,600 lbs./ sq. in.)	541 kg/cm² (7,700 lbs./ sq. in.)

Carbon steel
Seamless, hydraulic lap welded and Electric resistance welded
Molybdenum Steel seamless
Chromium-Molybdenum Steel seamless

The lowest value obtained on the following basis from

For temperatures upto and including 350°C (662°F) . . $\frac{\text{T.S.}}{3{\cdot}5}$ or $\frac{\text{Et}}{1{\cdot}6}$

For temperatures above 350°C (662°F) . . . . . $\frac{\text{Et}}{1{\cdot}6}$ or $\frac{\text{Sr}}{1{\cdot}6}$ or Sc

Where, T.S.= Minimum Tensile strength at 20°C (68°F)

Et = Yield point (0·2% proof stress) at the temperature t.

Sr = The average stress to produce rupture in 100,000 hours and in no case, more than 1·33 time the lowest stress to produce rupture.

Sc = The average stress to produce an elongation of 1% (creep) in 100,000 hours.

(11) (i) For regulation 351, the following shall be substituted, namely:—

"351. (a) The material shall comply with regulations 73 to 80.

(b) The maximum working pressure allowed on cast steel pipes shall be determined by the following formula:—

$$W.P. = \frac{2S\,(t - \cdot 015D - C)}{D} \quad \text{Eqn. (92)}$$

Where, t = minimum thickness

W.P. = Working Pressure

D = External diameter of pipe

S = Allowable working stress as specified in table 4.

C = 0·64 cm (0·25 in.)"

(ii) For the table 4, the following table shall be substituted, namely:—

TABLE 4

Maximum Permissible Working Stress for Carbon and Alloy Cast Steel Pipes
(*See* Regulation 351)

Lowest value obtained in each case at the specified temperature calculated on the following basis:—

For service temperature at or below 350°C (662°F) . . $\frac{T.S.}{3 \cdot 5}$ or $\frac{Et.}{1 \cdot 6}$

For service temperature above 350°C (662°F) . . . $\frac{Et}{1 \cdot 6}$ or $\frac{Sr}{1 \cdot 6}$ or Sc

T.S. = Minimum Tensile Strength of the material at room temperature.

Et = Warm yield point (0·2% proof stress) at temperature t.

Sr = The average stress at the service temperature to produce rupture in 100,000 hours and, in no case, more than 1·33 times the lowest stress to produce rupture at service temperature.

Sc = The average stress at service temperature to produce an elongation of 1% (creep) in 100,000 hours.

(12) For regulation 353, the following shall be substituted, namely:—

"353. *Flanges of Steam Pipes.*—(a) Flanges of steam pipes shall be made of cast steel or wrought steel made without a weld. They may be secured to the pipes by screwing, riveting or welding."

(13) For regulation 354, the following shall be substituted, namely:—

"354. *Screwed on flanges.*—Where flanges are secured by screwing the screw thread on the pipes and in the flanges shall be arranged to end at a point just inside the back of boss of the flange. After the flange has been screwed on, the pipe shall be expanded into the flange by a roller expander. Such screwed and expanded flanges may be used for steam for a maximum working pressure of 31·5 kg/cm^2 (450 lbs./sq. in.) and a maximum temperature of 399°C (750°F) and for feed for a maximum pressure of 42 kg/cm^2 (600 lbs./sq. in.)."

(14) For regulation 357, the following shall be substituted, namely:—

"357. *Welded on flanges.*—(a) Where flanges are welded on, the welding shall be done by the oxy-acetylene or metal arc process the latter with covered electrodes which shall comply with regulations 94 to 98.

(b) The proportion of the weld shall be as indicated in the Figure Nos. 28 to 34 of the following types:—

Type 1. 'Welding Neck' flange. Figure 28.

2. 'Face and Back' welded—on flange for metal arc welding. Figure 29.

3. 'Bore and Back' welded—on flange for metal arc welding. Figures 30 and 30A.

4. 'Face and Fillet' welded—on flange for metal arc welding. Figure 31.

5. 'Bore and Fillet' welded—on flange for metal arc welding. Figures 32 and 32-A.

6. 'Slip on' welded—on flange for metal arc welding. Figure 33.

7. 'Slip on' welded—on bossed flange for oxy-acetylene welding. Figure 34.

The flange shall not be a tight fit on the pipe.

The maximum clearance between the bore of the flange and the outside diameter of the pipe shall be 3 mm. (1/8") at any point, and the *sum of clearances diametrically opposite shall not exceed 5 mm.* (3/16 in.).

NOTE.—All dimensions shown in the figures of types 1 to 7 relate to finished sizes.

The design conditions for each type are as follows:—

Types 1, 2 and 3 flanges for all design pressure and temperature conditions.

Types 4 and 5 flanges for all pressure conditions up to and including 42 kg/cm^2 (600 lbs./sq. in.) and design temperature not exceeding 399°C. (750°F.).

Types 6 and 7 flanges for all pressure conditions up to and including 17·6 kg./cm^2 (250 lbs./sq. in.) and temperature not exceeding 399°C. (750°F.) except that Bossed flanges of type 6 shall not be used on pipes over 304 mm. (12") in nominal bore, nor Bossed flanges of type 7 on pipes over 152 mm. (6") in nominal bore.

(c) *Heat treatment after welding.*—Types 1, 2, 3, 4 and 5 carbon steel flanges welded on by the metal arc process shall have the welds stress relieved where the design depth of the weld recess is greater than 13 mm. ($\frac{1}{2}$").

All welds joining flanges to alloy steel pipes shall be stress relieved.

(d) Where type 1 flanges are attached by oxy-acetylene welding the welds shall be normalised.

(e) The procedure to be observed in the stress relieving and normalising of welds shall be in accordance with the following requirements:—

(i) *Stress relieving.*—The stress relieving temperature shall be:

for mild steel and carbon steel within the range 600/650°C. (1110/1200°F.).

for alloy steels within the range 630/660°C. (1170/1220°F.).

The stress relieving temperature shall be maintained for approximately one hour per 25 mm. (1 inch) of weld throat with a minimum of half an hour.

Stress relieving shall be carried out by one of the following methods:—

(a) Local heating using a portable muffle furnace, induction coils or other suitable heating appliance. Particular care shall be taken to apply heat uniformly over the area to be treated. The use of procedures

that do not provide adequate control for this purpose, such as manual operation gas torches, is not permissible. The temperature shall be measured by the thermo-couples peened, welded or otherwise suitably attached to the surface of the pipe and, where necessary, protected from frame impingement.

(b) Heating in a stationary industrial furnace. The temperature of the joint shall be measured by thermocouples so disposed within the furnace as to give a true measure of the joint temperature.

(ii) *Normalising.*—Welds in mild steel pipes shall be normalised by heating the metal to a temperature between 900 and 950°C. (1650—1740°F.), the temperature then being maintained for not less than two minutes for pipes up to and including 102 mm. (4") bore, and for not less than five minutes for pipes over 102 mm. (4") bore. Welds in pipes made from the alloy steel shall be normalised by heating the metal to a temperature between 925 and 975°C. (1700—1790°F.), the temperature then being maintained for not less than two minutes for pipes up to and including 102 mm. (4") bore, and for not less than five minutes for pipes over 102 mm. (4") bore. The higher temperatures of between 950 and 975°C. (1740—1790°F.) shall be used for alloy steels having a carbon content upto and including 0·12 per cent. and the lower temperatures of between 925 and 950°C. (1700—1740°F.) shall be used for alloy steels having a carbon content of more than 0·12 per cent. After normalising the joint shall be covered with a suitable muff or asbestos cloth to ensure slow and even cooling. The normalising of welds in pipes up to 102 mm. (4") bore may be carried out with welding flames, the temperature being judged with the aid of a colour card, or measured by means of one or more thermocouples or an optical pyrometer. The normalising of welds in pipes over 102 mm. (4") bore shall preferably be carried out in a portable pipe normalising furnace or muffle, the temperature being measured by means of one or more thermocouples or an optical pyrometer. The width of the zone to be heat treated to the specified temperature shall extend at least 13 mm. (½") on either side of the weld reinforcement."

(15) For clauses (b) and (c) of regulation 360, the following shall be substituted, namely:—

"(b) Where pipe having a wall thickness exceeding 13 mm. (½ in.) are butt-welded together they shall be effectively stress relieved in accordance with the following:—

The stress relieving temperature shall be:

For mild steel and carbon steel within the range 600/650°C. (1110/1200°F.).

For alloy steels within the range 630/660°C. (1170/1220°F.).

The stress relieving temperature shall be maintained for approximately one hour per inch of pipe thickness with a minimum of half an hour.

Heat treatment shall be carried out by one of the following methods:

(i) Local heating using a portable muffle furnace induction coils, or other suitable heating appliance. Particular care shall be taken to apply heat uniformly over the area to be treated. The use of procedures that do not provide adequate control for this purpose such as manual operation of gas torches, is not permissible. The temperature shall be maintained symmetrically, over a peripheral band of metal of a minimum width of three times the width of the butt weld preparation. The temperature shall be measured by thermocouples peened, welded or otherwise suitably attached to the surface of the pipe and, where necessary, protected from flame impingement.

(ii) Heating in a stationary industrial furnace. The temperature of the joint shall be measured by thermocouples so disposed within the furnace as to give a true measure of the joint temperature.

(c) Such Butt-welded joints conform to fig. 28.

(16) For clause (b) of regulation 361, the following clause shall be substituted, namely:—

(b) The thickness of the pipes, from which bends are made shall be such that the minimum thickness required by equation (91) is maintained throughout after the bending operation. The deviation from circularity in percentage at any cross-section of a bend shall be calculated by the following formula:—

$$C = \frac{D_{max.} - D_{min.}}{D} \times 100$$

This deviation shall not exceed $\frac{20D}{R}$

Where

C = The percentage deviation of circularity.

$D_{max.}$ = maximum external diameter of the pipe as gauged at the bend.

$D_{min.}$ = minimum external diameter of the pipe at gauged at the bend.

D = nominal external diameter of the pipe.

R = Radious of the bend on the central line of the bend.

(17) For regulation 362 the following shall be substituted, namely:—

"362. (a) *Branches, Bosses and Drain pockets.*—Branches, bosses and drain pockets welded to the pipes shall conform to the requirements of regulations 249—253. Branches shall not be welded to any main at an angle of less than 60°.

(b) *External reinforcement.*—If the thickness of the main or branches of a single or multiple branch piece is less than that given by the equation 91-A external reinforcement shall be provided. Such reinforcement may take the form as given in Figure 32-A or other reinforcement approved by the Chief Inspector applied to or around the junction between branch and main. Gusset plates attached longitudinally to the surfaces of either pipe, shall not be used.

(c) *Thickness where no external reinforcement is provided.*—Where more than one branch is attached to a pipe the opening of each branch shall be projected perpendicularly on the axis of the main and the distance between each pair of these projections measured. If the distance so measured between two branches is less than the sum of their bores, the two branches are deemed to affect each other; if this distance is equal to or greater than the sum of their bores, the two branches are deemed not to affect each other.

In calculating the reinforcement required, each branch is to be considered in turn together with all the branches by which it is affected.

(i) *A branch not affected by any other branch.*—Where no external reinforcement is to be applied to a branch piece the thickness of the branch shall be determined from Equation 91-A.

$$t_m = \frac{PD}{2\,Sex} + C \qquad \text{Equation 91-A.}$$

where t_m = minimum thickness of the branch.

P = Working pressure.

D = Outside diameter of branch.

S = Maximum permissible stress as specified in Table 3.

e = factor given in regulation 350.

$x = 1.—B\,(1—0{\cdot}7 \sin y)$ Equation 91-B.

B = ratio of bore of branch to bore of main.

y = angle between branch and main, in degrees.

C = 0·1 cm (·04 in.)

The value of t_m derived from Equation 91-A is the minimum thickness and further provision shall be made for any minus tolerance.

No reinforcement is required if—

$$B \text{ is less than } \frac{Y}{Y+90} \qquad \text{Equation 91-C.}$$

(ii) *A branch affected by one or more other branches.*—(See Figure 362/A.) Determine the 'X' values for each branch alone from Equation 91-B. Let 'X' be the value for the branch under consideration and Xa, Xb, etc., the value for the other branches.

Then $X_1 = 1—C\,(1—Xa)$ Equation 91-D.

$X_2 = 1—C\,(1—Xb)$

etc.

Where C is a factor the value of which is to be taken from Table 362/4.

The thickness of each branch which is a component of a multiple branch shall then be determined from Equation 91-E. Equation 91-C shall not apply:—

$$t_m = \left(\frac{PD}{2\,Sex}\right) \cdot \left(\frac{1}{X_1 \cdot X_2 \cdot \ldots}\right) + C \ldots \text{Equation 91-E.}$$

Where C = 1 mm. (·04 in.)

TABLE 362/4

$\frac{L}{d_1+d_2}$	C
1 or greater	0
·9	0·10
·8	·34
·7	·66
·6	·80
·5	·90
·4	·94
·3	·97
·2	·98
·1	·99
·0	1

(L = distance between Projections of branch bores, d_1 and d_2)

Intermediate values by linear interpolation:

It is to be specially noted that a branch may form part of two distinct multiple branches, when its thickness shall be the greater of the thickness calculated for it as a component of each multiple branch.

(iii) *Mains.*—(See Figures 362/A, 362/B, 362/C and 362/D.) The thickness of a main carrying a single or a multiple branch shall be determined as for the single branch or one component of the multiple branch except that the symbols 'D' and 'e' shall apply to the main.

The thickness of a main carrying more than one branch, single or multiple, shall be the greatest of the thickness of the main calculated in connection with each branch separately.

The additional thickness of a main for branch reinforcement shall extend over the length covered by the branch and beyond it for a distance not less than the bore of the branch on each side.

(18) In regulation 364, in the second line, the words "wrought iron or" shall be omitted.

(19) In regulation 368, the words "iron and" in the second line shall be omitted.

(20) For regulation 370, the following shall be substituted, namely:—

"370. *Flexibility.*—The pipes shall be arranged so that the system is sufficiently flexible to absorb the whole of their expansion without the sum of the longitudinal pressure stress and the longitudinal bending stress exceeding the stress (S) given in Table 3, under the operating conditions within the limits of the working pressures and temperatures, except where the torsional stress is significant in which case the resultant combination of stress shall be taken into account. Where practicable, the requisite flexibility shall be provided in the layout of the pipes without having recourse to special expansion bends or expansion joints except for the safety valve discharge piping. The use of sliding expansion joints is prohibited. Additional stresses not specifically allowed for in the calculation such as circumferential bending stress, or stress concentrations produced by abrupt changes of section should be kept to a reasonable minimum."

(21) For regulation 374, the following regulation shall be substituted, namely:—

"374. *Test pressures.*—(a) Each completed pipe and fitting shall be tested by hydraulic pressure to the test pressure H lbs./sq. in. determined from the following equation subject to a maximum test pressure of 316·3 kg/cm² (4500 lbs./sq. in.).

$$H = 1{\cdot}7\ P \times \frac{S \text{ at } 260°C\ (500°F).}{S \text{ at } T}$$

P = Maximum permissible pressure.

S = Maximum permissible working stress.

T = Design temperature.

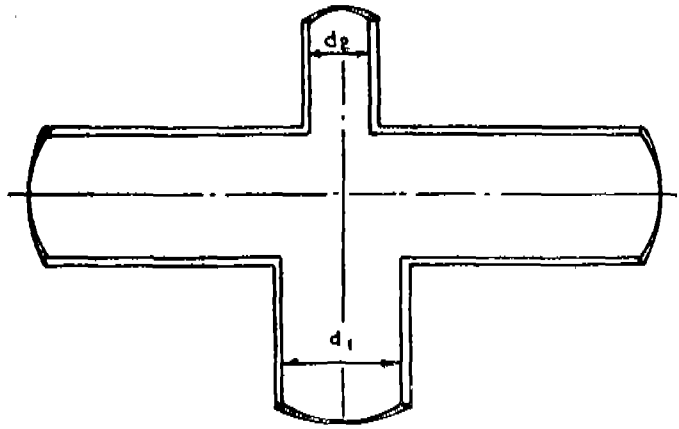
(b) Pipes and fittings with flanges for steam pressures exceeding 7 kg/cm² (100 lbs. per sq. in.) shall be tested with blank flanges bolted or clamped on. All other pipes, if straight, may be tested between the heads of an ordinary hydraulic pipe testing machine.

(c) Where the joints in a pipe system are of welded construction, the system shall, after erection, be tested hydraulically to twice the maximum permissible pressure, where the pressure does not exceed 35 kg/cm² (500 lbs./sq. in.) and to 1½ times the maximum permissible pressure or 70 kg/cm² (1000 lbs./sq. in.), whichever is the greater where the maximum permissible pressure exceeds 35 kg/cm² (500 lbs./sq. in.):

Provided that stress due to all causes including the stress due to the hydraulic test pressure shall not exceed 40 per cent of the minimum tensile strength of the material of pipes.

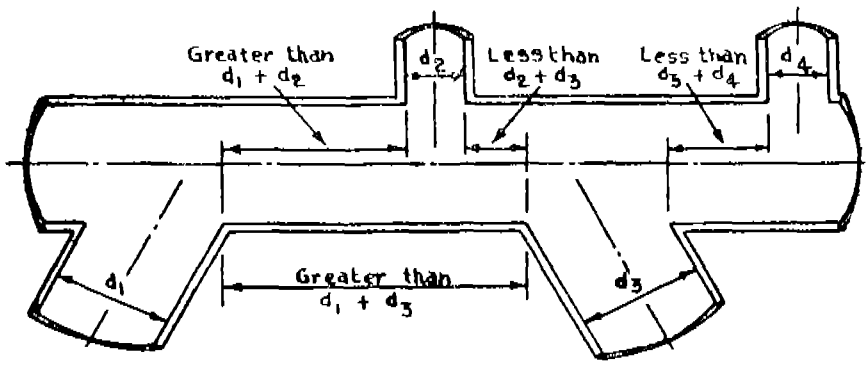
(d) Special arrangements shall be made, according to circumstances, for testing bends and other fittings which are not flanged."

TYPICAL BRANCH PIECES



d_1 and d_2 form a pair affecting each other

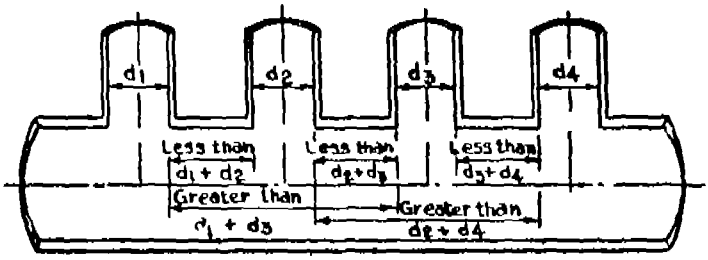
Fig. 362/A



d_1 is unaffected by the other branches
d_2 is affected by d_3
d_3 is affected by d_2 and d_4
d_4 is affected by d_3

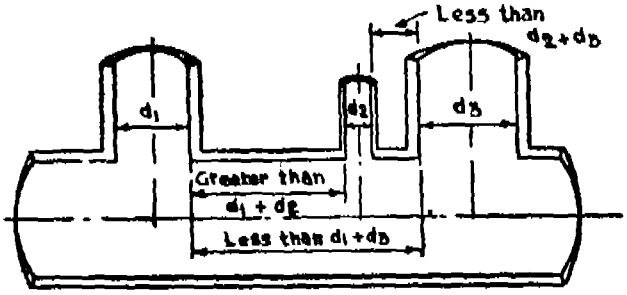
Fig. 362/B

TYPICAL BRANCH PIECES



d_1 is affected by d_2
d_4 is affected by d_3
d_2 is affected by d_1 and d_3
d_3 is affected by d_2 and d_4

Fig. 362/C



d_1 is affected by d_3
d_2 is affected by d_3
d_3 is affected by d_1 and d_2

Fig. 362/D

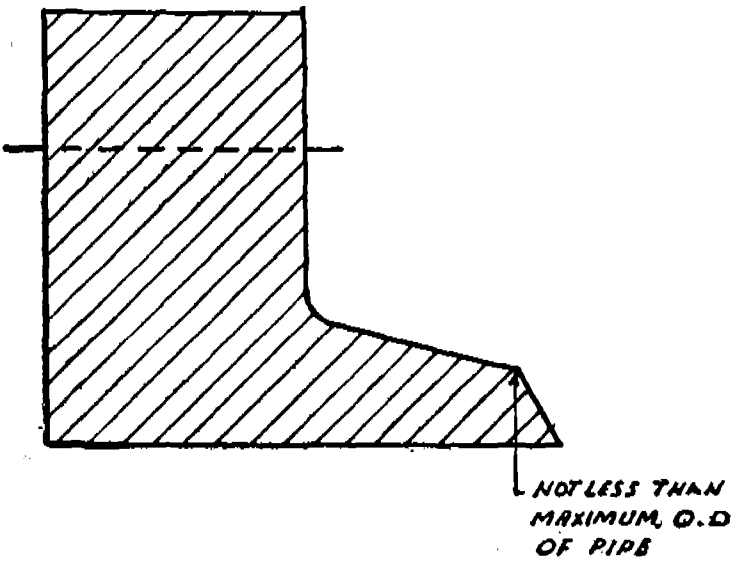


FIG. NO. 28.

THIS FLANGE IS SUITABLE FOR ALL DESIGN PRESSURE AND TEMPERATURE CONDITIONS

NOTE:— FOR DETAILS OF WELD PREPARATION SEE FIG. NOS 28(1) TO 28(X)

WELDING NECK FLANGE

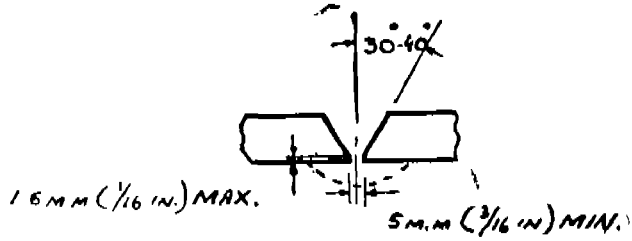


FIG. NO. 28 (i)

PLAIN VEE FOR USE WITH BACKING RING.

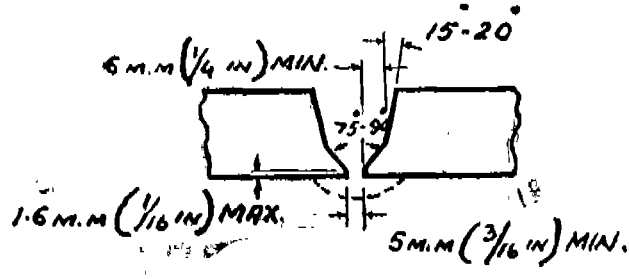


FIG. NO. 28 (ii)

DOUBLE ANGLE VEE FOR USE WITH BACKING RING
(PIPES OVER 13 M.M (1/2 IN) THICK)

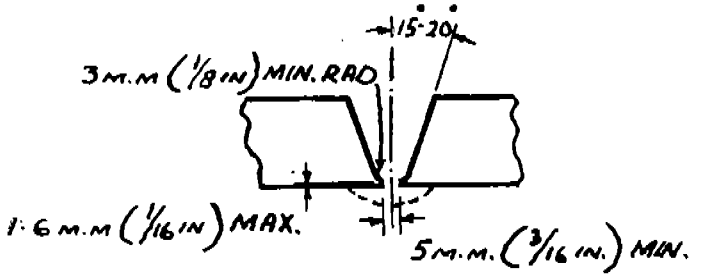


FIG. NO. 28 (iii)(a) NORMAL PREPARATION.

U-GROOVE FOR USE WITH BACKING RING
(PIPES OVER 13 M.M (1/2 IN) THICK)

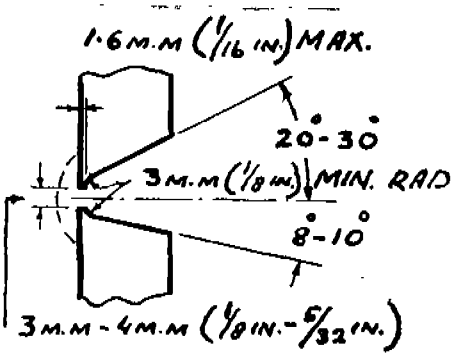
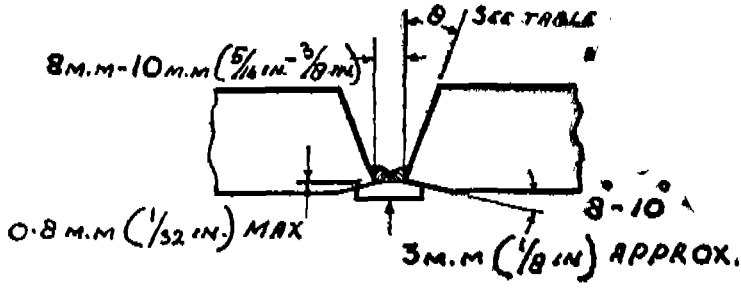


FIG. NO. 28 (iii)(b) PERMISSIBLE ALTERNATIVE PREPARATION FOR VERTICAL OR NEARLY VERTICAL PIPE

U-GROOVE FOR USE WITH BACKING RING
(PIPES OVER 13 M.M (1/2 IN.) THICK)



PIPE THICKNESS		θ
M.M.	IN	DEGREES.
≤25	≤1	16 - 20
>25≤38	>1≤1½	20 - 24
>38	>1½	23 - 27

FIG. No. 28 (iv)

PREPARATION OF GROOVE FOR USE WITH TAPER BACKING RING AND DOUBLE ROOT RUN.
(FOR PIPES OVER 8M.M (5/16 IN) THICK)

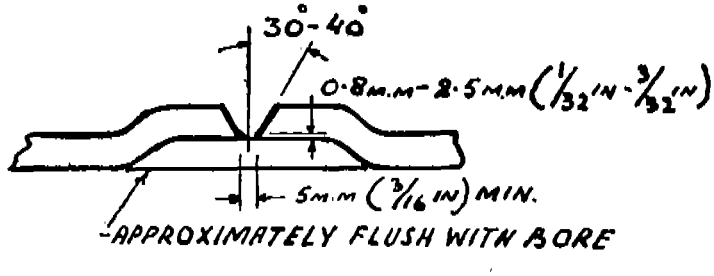


FIG. No. 28 (v)(a) FOR PIPES 13 M.M (1/2 IN) AND THINNER

GROOVE FOR USE WITH RECESSED BACKING RING

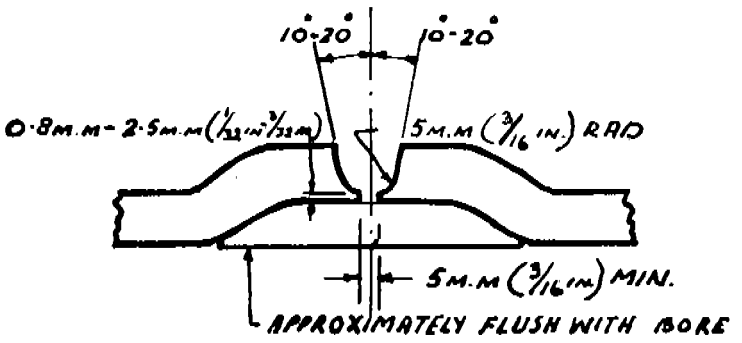


FIG. NO. 28(v)(L) FOR PIPES THICKER THAN 13M.M (1/2IN.)

GROOVE FOR USE WITH RECESSED BACKING RING

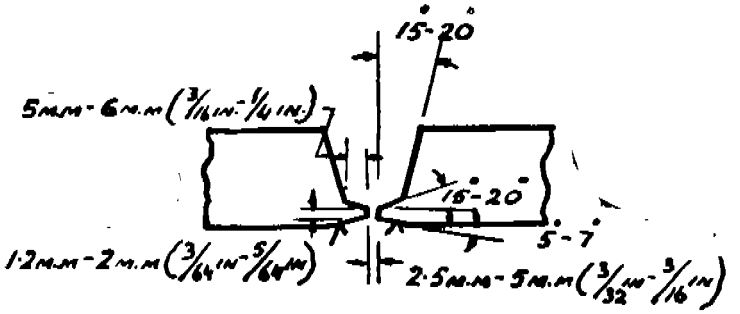


FIG. No. 28(vi)(a) NORMAL PREPARATION

DOUBLE ANGLE VEE FOR USE WITH OXY-ACETYLENE BASE RUN.

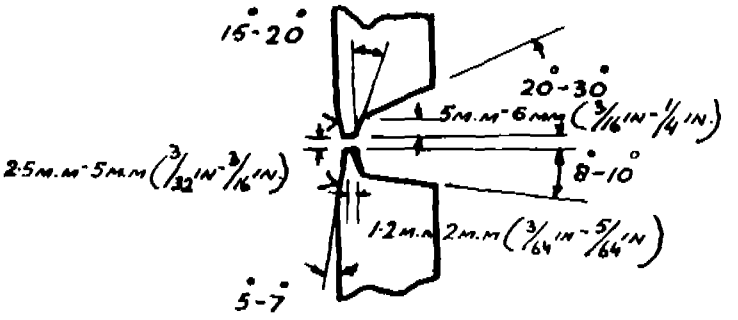


FIG. No. 28(VI)(b) PERMISSIBLE ALTERNATIVE PREPARATION FOR VERTICAL OR NEARLY VERTICAL PIPE.

DOUBLE ANGLE VEE FOR USE WITH OXY-ACETYLENE BASE RUN.

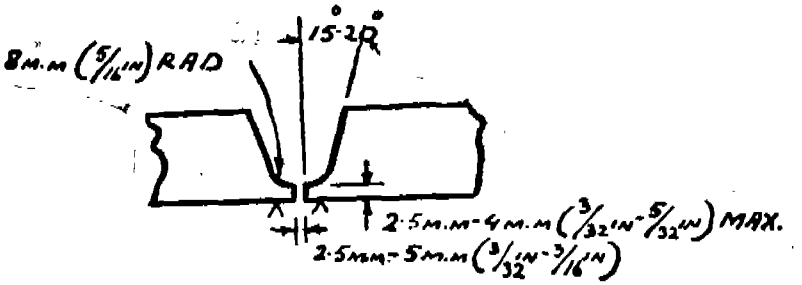


FIG. NO. 28(VII)(a) NORMAL PREPARATION

U-GROOVE FOR USE WITH OXY-ACETYLENE BASE RUN.

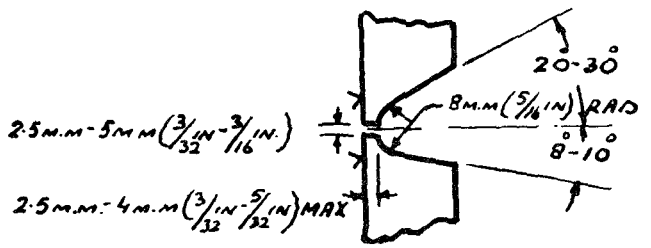


FIG. NO. 28(VII)(L) PERMISSIBLE ALTERNATIVE PREPARATION FOR VERTICAL OR NEARLY VERTICAL PIPE.

U-GROOVE FOR USE WITH OXY-ACETYLENE BASE RUN.

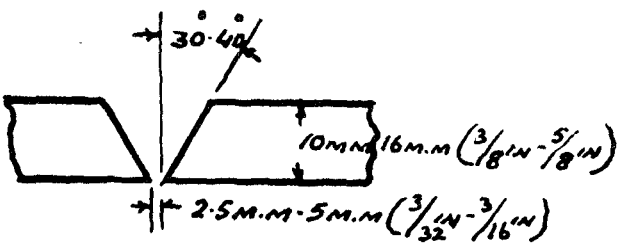


FIG. NO. 28(VIII)

PLAIN VEE FOR USE WITH OXY-ACETYLENE BASE RUN (PIPES 10 TO 16 M.M (3/8 TO 5/8 IN) THICK INCLUSIVE)

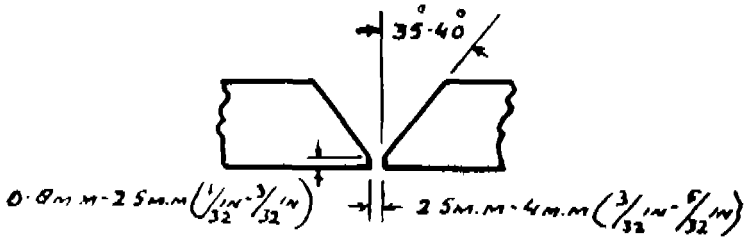


FIG. NO. 28 (IX)(a) NORMAL PREPARATION.

PLAIN VEE FOR USE WITHOUT BACKING RING

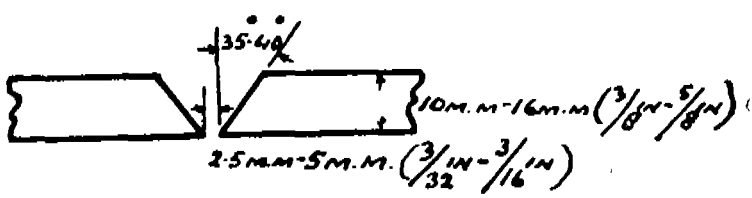


FIG. NO. 28 (IX)(b) FOR USE WITH SPECIAL WELDING TECHNIQUE

PLAIN VEE FOR USE WITHOUT BACKING RING

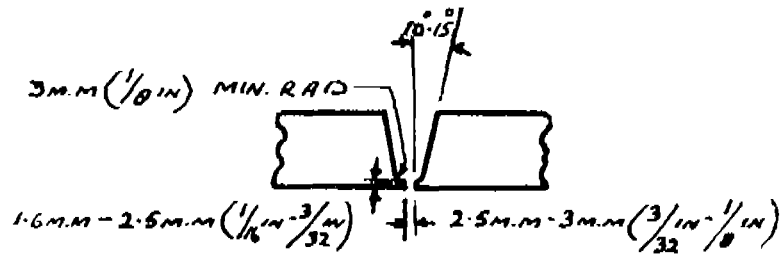


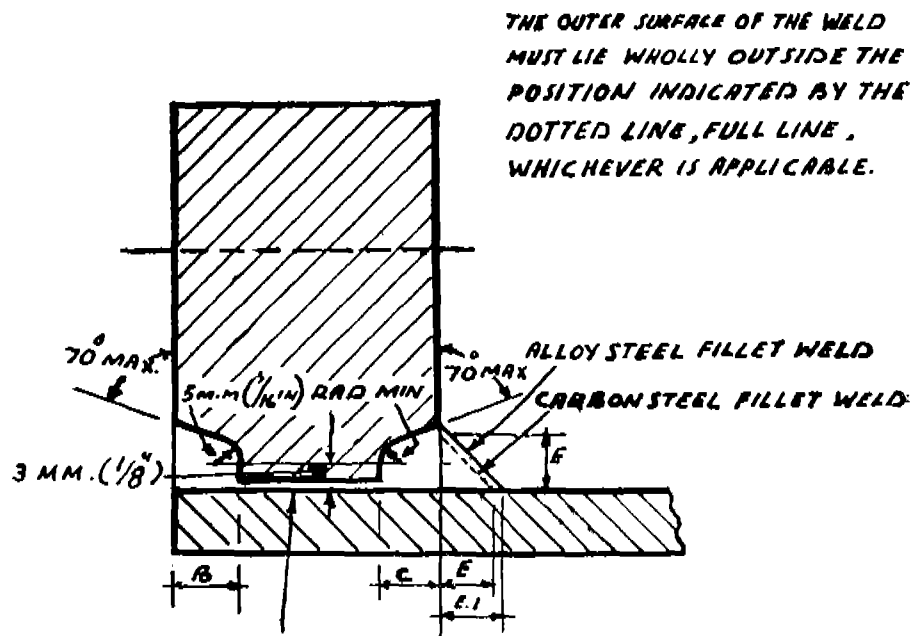
FIG. NO. 28 (X)

SINGLE U FOR USE WITHOUT BACKING RING

* *Shape of profile.*—Unless the weld is dressed flush, there shall be external weld reinforcement, preferably within the limits recommended in Table below and this reinforcement shall be substantially symmetrical about the centre line of the joint. The shape of the reinforcement may vary according to the type of electrode or welding technique used and the welding position, but shall in all cases be of smooth contour, the profile running out smoothly into the pipe on each side without notching or reduction of thickness of the pipe at the edges of the weld.

Amount of Weld Reinforcement

Over		Pipe thickness		Recommended limits			
		Upto and including		Minimum		Maximum	
mm.	in.	mm.	in.	mm.	in.	mm.	in.
—	—	6	¼	1·6	1/16	3	1/8
6 mm.	¼	13	½	1·6	1/16	5	3/1
13 mm.	½	—	—	1·6	1/16	6	¼



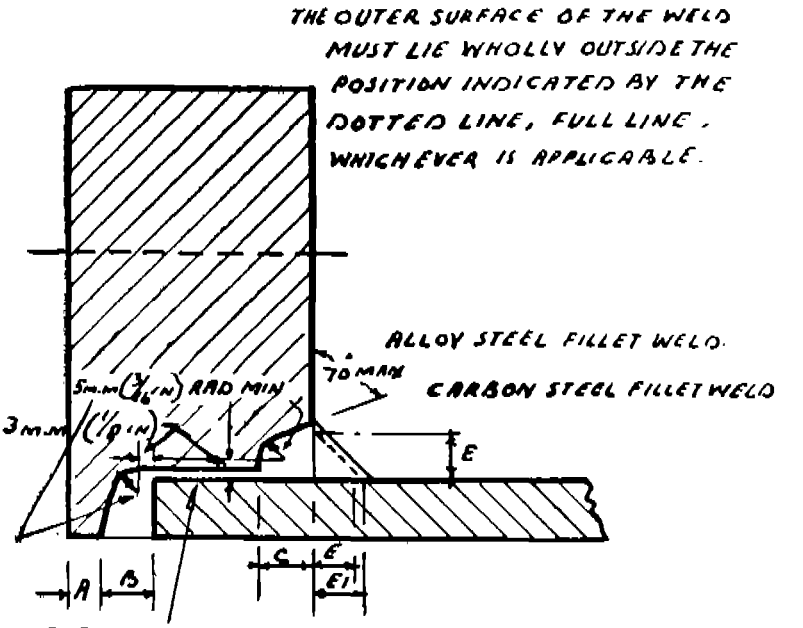
FOR CLEARANCE BETWEEN FLANGE BORE AND O.D. OF PIPE (SEE REGN. 357(4))

FIG. NO. 29.

CARBON STEEL PIPES	B = t BUT NOT LESS THAN 6m.m (1/4 IN).
ALLOY STEEL PIPES	B = t BUT NOT LESS THAN 5m.m (3/16 IN.)
CARBON STEEL PIPES.	E BUT 6mm (1/4 IN) FOR PIPES 13m.m (1/2 IN) AND 19mm (3/4 IN) BORE C = NOT LESS 8m.m (5/16 IN) FOR PIPES 25m.m (1 IN) TO 38m.m (1 1/2 m.m) BORE THAN 10m.m (3/8 IN) FOR PIPES 51mm (2 IN) BORE AND OVER.
ALLOY STEEL PIPES	2t BUT 6mm (1/4 IN) FOR PIPES 13mm (1/2 IN) AND 19mm (3/4 IN) BORE C = NOT LESS 8m.m (5/16 IN) FOR PIPES 25mm (1 IN) TO 38m.m (1 1/2 IN) BORE THAN 10m.m (3/8 IN) FOR PIPES 51mm (2 IN) BORE AND OVER.
CARBON STEEL PIPES	E = t BUT NOT LESS THAN 6m.m (1/4 IN)
ALLOY STEEL PIPES	E1 = HEIGHT OF WELD RECESS.

DIMENSIONS B AND C ARE MINIMA AFTER MACHINING FLANGE TO FINAL THICKNESS. THIS FLANGE IS SUITABLE FOR ALL DESIGN PRESSURE AND TEMPERATURE CONDITIONS.

'FACE AND BACK' WELDED-ON FLANGE FOR METAL-ARC WELDING.



FOR CLEARANCE BETWEEN FLANGE BORE AND O.D. OF PIPE SEE REGN. 357(6)

FIG. NO. 30.

CARBON STEEL AND ALLOY STEEL PIPES	$A = \frac{1}{2}t$ BUT NOT LESS THAN 5m.m (3/16 IN)
CARBON STEEL AND ALLOY STEEL PIPES.	B = 8m.m (5/16 IN) MIN. WHERE t IS NOT MORE THAN 8m.m (5/16 IN) = (t - 1.6m (1/16 IN)) WHERE t IS OVER 8m.m (5/16 IN) UPTO AND INCLUDING 14.5m.m (9/16 IN) = (t - 3m.m (1/8 IN)) WHERE t IS OVER 14.5m.m (9/16 IN) UP TO AND INCLUDING 22m.m (7/8 IN) = (t - 6m.m (1/4 IN)) WHERE t IS OVER 22m.m (7/8 IN)
CARBON STEEL PIPES	C = t BUT NOT LESS THAN 10m.m (3/8 IN)
ALLOY STEEL PIPES	C = 2t BUT NOT LESS THAN 10m.m (3/8 IN)
CARBON STEEL PIPES	E = t BUT NOT LESS THAN 6m.m (1/4 IN)
ALLOY STEEL PIPES	E1 = HEIGHT OF WELD RECESS.

DIMENSIONS A AND C ARE MINIMA AFTER MACHINING FLANGE TO FINAL THICKNESS. THIS WELD PREPARATION SHALL NOT BE USED WITH PIPES OF LESS THAN 76m.m (3 IN) MIN. BORE.

'BORE AND BACK' WELDED-ON FLANGE FOR METAL-ARC WELDING

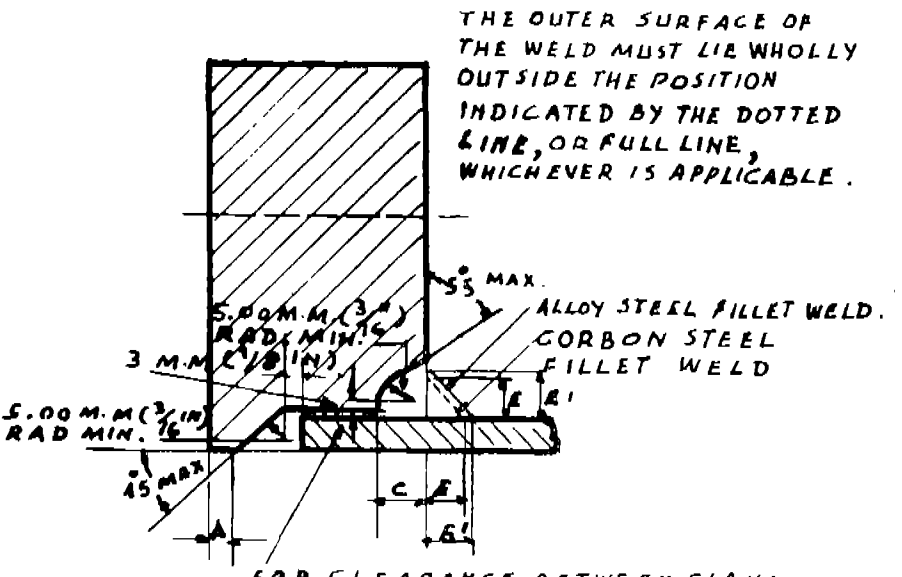


FIG. NO. 30-A.

CARBON STEEL AND ALLOY STEEL PIPES	$A = 1/2\,t$ BUT NOT LESS THAN 5.0 MM (3/16 IN)
CARBON STEEL PIPES	$C = t$ BUT NOT LESS THAN 10.0 M.M. (3/8 IN)
ALLOY STEEL PIPES	$C = 2t$ BUT NOT LESS THAN 10.0 M.M (3/8 IN)
CARBON STEEL PIPES	$E = t$ BUT NOT LESS THAN 6.0 M.M (1/4 IN)
ALLOY STEEL PIPES	$E' = 6.00$ M.M (1/4 IN) $+ 2/3\,t$ BUT NOT LESS THAN t

t = CALCULATED THICKNESS OF PIPE AS DERIVED FROM EQN. 31.

DIMENSIONS A & C ARE MINIMA AFTER MACHINING FLANGE TO FINAL THICKNESS. THIS WELD PREPARATION SHALL NOT BE USED WITH PIPES LESS THAN 76 M.M (3 IN) MINIMUM BORE.

WELD PREPARATION FOR USE ONLY WITH FLANGES POSITIONALLY WELDED ON.

BORE AND BACK WELDED-ON FLANGE FOR METAL ARC WELDING.

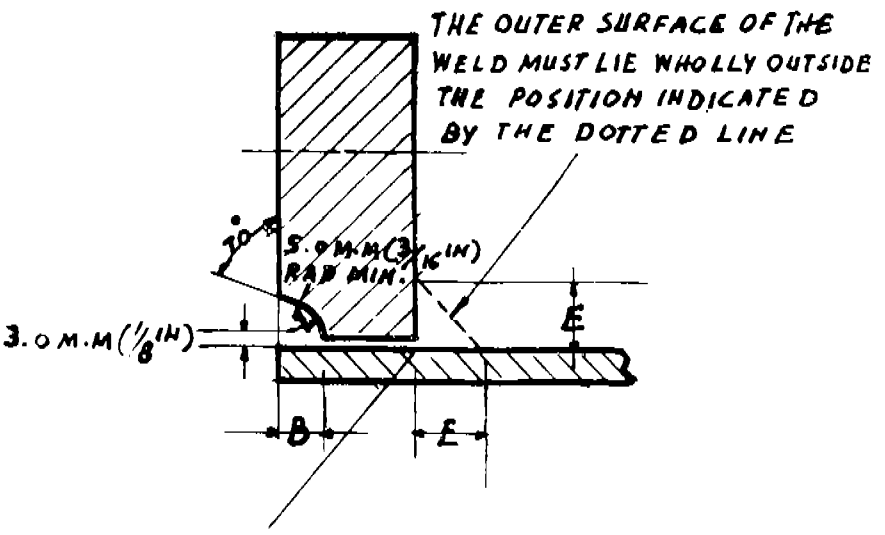


FIG. NO. 31.

$B = t$ BUT NOT LESS THAN 5.0 M.M. (3/16 IN)

$E = 1\frac{1}{2}t$ BUT NOT LESS THAN 6.0 M.M. (1/4 IN)

t = CALCULATED THICKNESS OF PIPE AS DERIVED FROM EQN 9).

DIMENSION B IS THE MINIMUM AFTER MACHINING FLANGE TO FINAL THICKNESS

FACE AND FILLET WELDED-ON FLANGE FOR METAL-ARC WELDING.

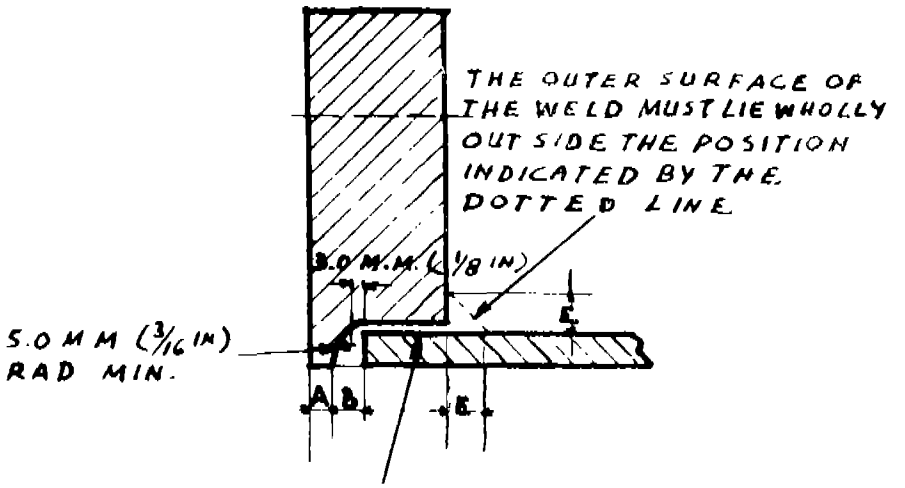


FIG. NO. 32.

A = 1/2 t BUT NOT LESS THAN 5.00 M.M. (3/16 IN).
*8.0 M.M. (5/16 IN) MINIMUM WHERE t IS NOT MORE THAN 8.0 M.M. (5/16 IN)

B = (t - 1.6 M.M (1/16")) WHERE t IS OVER 8.0 M M. (5/16") UPTO AND INCLUDING 14.50 M.M. (9/16 IN).
= [t - 3.0 M.M. (1/8")] WHERE t IS OVER 14.50 M.M. (9/16 IN) UPTO AND INCLUDING 22.00 M.M. (7/8 IN).
= t - 6.0 M.M (1/4 IN) WHERE t IS OVER 22.0 M.M. (7/8 IN).

E = 1 1/2 t BUT NOT LESS THAN 6.00 M.M. (1/4 IN).

t = CALCULATED THICKNESS OF PIPE AS DERIVED FROM EQN 31.

DIMENSION 'A' IS THE MINIMUM AFTER MACHINING FLANGE TO FINAL THICKNESS. THIS WELD PREPARATION SHALL NOT BE USED WITH PIPES OF LESS THAN 76.00 M.M. (3 IN.) BORE.

BORE & FILLET WELDED-ON FLANGE FOR METAL ARC WELDING.

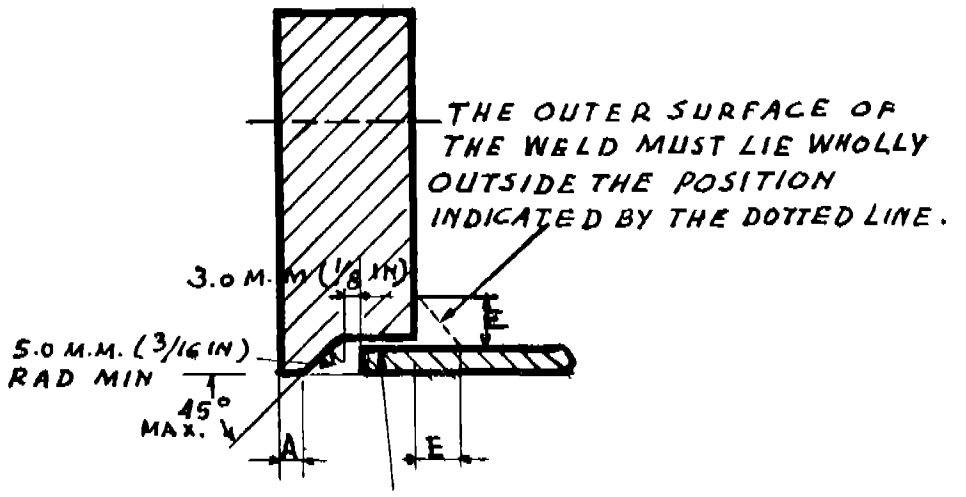


FIG. NO. 32-A

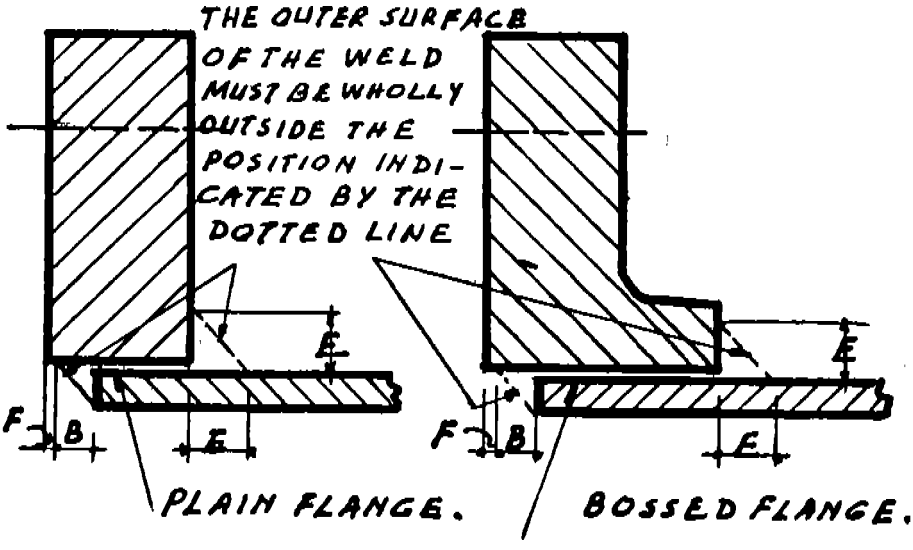
$A = \frac{1}{2} t$ BUT NOT LESS THAN 5.0 M.M. (3/16 IN)
$E = 1\frac{1}{2} t$ BUT NOT LESS THAN 6.0 M.M. (1/4 IN)

t = CALCULATED THICKNESS OF PIPE AS DERIVED FROM EQN 9)

DIMENSION 'A' IS THE MINIMUM AFTER MACHINING FLANGE TO FINAL THICKNESS. THIS WELD PREPARATION SHALL NOT BE USED WITH PIPES OF LESS THAN 76.0 M.M. (3 IN.) MINIMUM BORE.

WELD PREPARATION FOR USE ONLY WITH FLANGES POSITIONALLY WELDED ON

'BORE AND FILLET' WELDED-FLANGE FOR METAL-ARC WELDING



FOR CLEARANCE BETWEEN FLANGE BORE & O.D. OF PIPE (SEE REGN. 357 (a))

FIG. NO. 33.

$B = t$

$E = 1\frac{1}{2}t$ BUT NOT LESS THAN 5.0 M.M. (3/16 IN)

$F = 1.6$ M.M (1/16 IN) MAX

t = CALCULATED THICKNESS OF PIPE AS DERIVED FROM EQN. 91.

ALL DIMENSIONS ARE FINISHED SIZES.

THE BOSSED FLANGE MAY BE USED ON PIPES UPTO AND INCLUDING 305 M.M. (12 IN.) NOMINAL BORE

'SLIP-ON' WELDED-ON FLANGE FOR METAL-ARC WELDING.

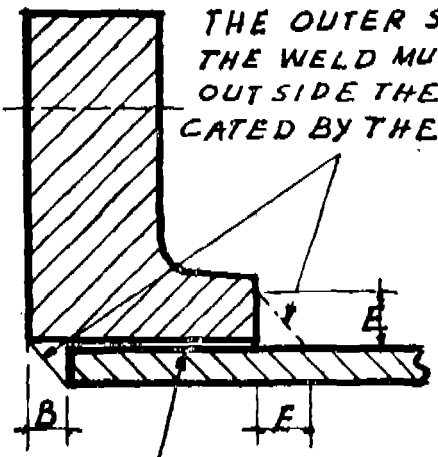


FIG. NO. 34.

$B = t$

$E = 1\frac{1}{2}t$ BUT NOT LESS THAN 5.0 M.M. (3/16 IN).

t = CALCULATED THICKNESS OF PIPE AS DERIVED FROM EQN. 91.

ALL DIMENSIONS ARE FINISHED SIZES.

THIS TYPE SHALL BE USED ONLY FOR PIPES UPTO AND INCLUDING 153 M.M. (6 IN.) NOMINAL BORE.

'SLIP-ON' WELDED-ON BOSSED FLANGE FOR OXY-ACETYLENE WELDING.

[No. S&PII/BL-304(12)/55.]

S. N. SEN GUPTA, Secy.
Central Boilers Board.

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